FRT

manufacturer:

EFRATOM

Time and Frequency Systems

INSTALLATION AND OPERATION MANUAL

RUBIDIUM FREQUENCY STANDARD MODEL model: FRT

MP MASTER

MA35362

WARRANTY

CERTIFICATION

Efratom certifies that this instrument was thoroughly inspected and tested, and in perfect working order at the time of shipment.

WARRANTY AND ASSISTANCE

Efratom's products are warranted against defects in materials and workmanship during a period of one year from the date of shipment, or in the case of certain major components listed in the manual, for the specified period.

The liability under this warranty is limited to replacing or repairing any products or components thereof returned to Efratom.

The warranty does not extend to any item which has been subjected to misuse, neglect, accident, repair, or alteration by others than Efratom.

In no event shall Efratom be liable for consequential damages. Whenever a product requires service, contact the Efratom representative or Efratom's Sales Department for assistance.

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SECTION I

GENERAL INFORMATION

1.1 DESCRIPTION

1.2 The traditional basic design of a passive rubidium gas cell standard consists of a spectral lamp, a filter cell, the microwave cavity containing the gas cell, a detector, and a slave oscillator which is stabilized against the natural atomic resonance, the hyperfine transition of Rubidium 87. Using isotope mixtures within the spectral lamp and cell, Efratom has developed an integrated system without a filter cell, which allows the miniaturization of the standard, and also maintains excellent long term stability of typically better than 1×10^{-11} per month.

1.3 Efratom Model FRT contains a miniaturized Model FRK atomic frequency standard. Frequency dividers and buffer amplifiers provide 10 MHz, 5 MHz, 1 MHz, and 0.1 MHz, available from BNC connectors on the front and rear panels. A helipot mounted on the front panel permits fine frequency adjustments.

1.4 A regulated power supply for standard utility lines and a buffered standby battery are provided to assure uninterrupted operation in case of primary power failure or during transportation.

1.5 The Model FRT can be installed in one-half of a standard 19" rack or into a portable case for field use.

1.6 CIRCUIT CHECKS

On the front panel, the METER FUNCTION switch and meter provide for monitoring the VCXO CONTROL VOLTAGE, RUBIDIUM LAMP light voltage, DC SUPPLY voltage, and the battery CHARGING CURRENT. The OPERATION indicator verifies that the VCXO is locked to the Rb_{87} atomic resonance. The 10 MHz, 5 MHz, 1 MHz, and 0.1 MHz frequency output levels are approximately 1 V rms when terminated with 50 ohms.

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1.7 ADD-ON OPTIONS

1. The Efratom clock Model EDU provides precise time-of-the-day, displayed with LED'S or in BCD code TTL compatible, a one pulse per second (1 pps) and a programmable leap second correction. A 6-digit thumb-wheel switch allows adjustments of the clock pulse in 1 μs increments.
2. A LF/VLF receiver-controller Model EFR with selectable long time constants (1 to 5 days) enables synchronization to standard frequency transmitters. An error signal is derived to correct for possible long term frequency drifts of the Model FRT. The system thus offers an economical alternative to a cesium standard.

1.8 SPECIFICATIONS

1.9 Table 1-1 lists the technical specifications for the Model FRT.

1.10 APPLICATIONS

1.11 The Model FRT is used as a master oscillator in laboratories, for precise timekeeping, in communication and navigation systems, and for calibration of crystal oscillators, especially where several standard frequencies are required simultaneously. Further applications include TV frequency control, radio astronomy, doppler radar, and many others.

1.12 Connected to Efratom's receiver/controller Model EFR, the FRT can be synchronized and controlled by any LF or VLF standard frequency transmitter, and so maintain an accuracy and stability of better than a few parts in 10^{-12}

1.13 ACCESSORIES

1.14 STANDARD SUPPLIED ACCESSORIES

1.15 AC line cord, Switchcraft, p/n P-2392 or equivalent
Mating connector for J9, DC INPUT, Amphenol p/n 91-T-3261-1
Mating connector for J11, REMOTE MONITOR, Amphenol, p/n 91-T-3361-1
Fuse - .63 A, 250 V, Littlefuse, Type T "slo-blo" p/n 213.700
Fuse - 3.15 A, 250 V, Littlefuse, Type T "slo-blo" p/n 213003
Fuse - 3 A, 125 V, Littlefuse, Axial Lead Picofuse p/n 275003

1.16 OPTIONAL ACCESSORIES

1.17 Spare fuses
Spare Rb-lamp, Efratom p/n EEK-02
Lamp replacement tool, Efratom
Instrument case, Efratom p/n EEK-30
19" rack mounting hardware, Efratom p/n EEK-31
Mating connector for J10, AUX. EQPT., Amphenol p/n 91-T-3360-1

TABLE 1-1 SPECIFICATIONS

	FRT-L	FRT-H
Output:	10 MHz, 5 MHz, 1 MHz, 0.1 MHz both front and rear, 1 Vrms into 50 ohms, sinewave. OPTION: 1 PPS instead of one listed frequency.	
Signal to Noise SSB 1 Hz BW	>120 dB at 100 Hz >145 dB at 1000 Hz from carrier	
Long Term Stability	$<4 \times 10^{-11}$/month	$<1 \times 10^{-11}$/month
Short Term Stability	3×10^{-11} τ = 1 sec 1×10^{-11} τ = 10 sec 3×10^{-12} τ = 100 sec	1×10^{-11} τ = 1 sec 4×10^{-12} τ = 10 sec 1×10^{-12} τ = 100 sec
Trim Range	2×10^{-9}	1×10^{-9}
Fine Tuning Resolution	2×10^{-12}	1×10^{-12}
Environmental Effects		
Voltage Variation	$<1 \times 10^{-11}$/10% VAC	
Operating Temperature	$<4 \times 10^{-10}$ from -10°C to +50°C	$<1 \times 10^{-10}$ from -10°C to +50°C
Storage Temperature	-40°C to +60°C	
Magnetic Field	$<4 \times 10^{-13}$/Am^{-1} (3×10^{-11}/0.1 millitesla)	
Altitude	$<1 \times 10^{-13}$/mbar (sea level to 12,000 m)	
Humidity	95% MIL-T-5422F	
General Information		
Warm-up Characteristics	<10 minutes to reach 2×10^{-10} at 25°C ambient	
Input Power	50 W at 115/220 VAC (+10%, -15%),47-400Hz,<30 W at 23-32VDC	
Internal Battery	More than 3 hours capacity at 25°C ambient. Automatic recharge	
Connectors	BNC frequency outputs,ext.battery,aux.equipment,remote monitor	
Controls/Indicators	Power and Operation: LED. Frequency: vernier,switch,and meter. Monitor signals: VCXO control voltage,Rb-lamp, DC supply voltage, charging current.	
Size	150 x 235 x 400 mm(5.9 x 9.25 x 15.75 in) with instrument case EEK-30. Suitable for 19" rack mounting with EEK-31	
Weight	12 Kg (27 lbs) with battery and portable case. 9 Kg (20 lbs.) without portable case.	
Warranty	1 year (lamp and resonance cell - 5 years.)	

SECTION 2

INSTALLATION

2-1. UNPACKING AND INSPECTION

2-2. As soon as the instrument is received, verify that it is intact and as ordered. Inspect it for damage. If any shipping damage is found, notify the carrier and inform Efratom.

2-3. As soon as possible, the instrument should be installed and given a thorough electrical inspection. Should the instrument fail to operate properly, immediately contact Efratom and refer to model number and serial number.

2-4. STORAGE AND SHIPMENT

2-5. Temperature conditions during storage should be as follows:

Maximum Temperature: +60°C (140°F)
Minimum Temperature: -40°C (-40°F)

2-6. To protect your instrument during shipment or storage, use the best packing methods available.

2-7. ELECTRICAL CONNECTIONS

2-8. LINE VOLTAGE

2-9. The Model FRT can be operated from either 115 VAC or 220 VAC (47-400Hz) power lines. A jumper wire inside the power supply, as noted on the power supply schematic, permits quick conversion for operation from either voltage. The instrument is supplied with a 115 V fuse. The fuse sizes are:

F1: .7 A
F2, F3: 3 A

2-10. POWER CABLES

2-11. The Model FRT is equipped with a detachable three-conductor AC power cable and a detachable three-conductor battery cable plug.

2-12. After connecting one or both cables, the instrument is ready for operation as indicated by the POWER indicator on the front panel.

2-13. OPERATION AS BENCH OR RACK INSTRUMENT

2-14. The FRT can be mounted in one-half of a standard 19" rack or located on a bench. For rack operation, mounting hardware accessory parts set EEK-31 should be used. The FRT is inserted on the track guiderails of the rack mounting hardware and tightened with a set screw at the front panel. In addition, the FRT can be mounted in a portable instrument case, part number EEK-30, as an alternate to rack mounting.

2.15. INSTALLATION LOCATION

2-16. Strong magnetic fields or large spikes on the powerlines affect the frequency stability to some extent.

NOTE:

Avoid installing the FRT near strongly radiating equipment like generators, transformers, etc., and/or provide spike suppressors and additional magnetic shielding.

SECTION 3

OPERATION

3-1. INTRODUCTION

3-2. This section provides operating and turn-on procedures for the Model FRT. Figures 3-1 through 3-4 depict locations of modules, front and rear panel controls, and connectors.

3-3. OPERATING PROCEDURE

3-4. POWER SUPPLY

3-5. The FRT can be operated from standard AC lines, 115/220 VAC -10% to +15% 47-400Hz, the built-in battery, or from an external DC source at 23 to 32 VDC.
AC and DC sources can be connected simultaneously.
AC power requirements are approximately 85 VA during warm-up, declining to 40 VA during normal operation.
External DC requirements are 2.2 A for initial warm-up, declining to approximately 0.9 A. The maximum ripple shall not exceed 1mV pp.

3-6. TURN-ON

3-7. If the battery is not fully charged, make sure that the switch labeled INT. BATTERY is in the OFF position before turn-on.

3-8. Plug in the AC power cord. The POWER indicator at the front panel will illuminate. After 5 to 10 minutes the OPERATION indicator will illuminate to verify that the VCXO is phase locked to the rubidium atomic resonance. Occasional short blinking of the OPERATION indicator may occur prior to warm-up. This is of no significance.

3-9. After the OPERATION indicator is on, the INT. BATTERY switch can be set to the ON position to start charging the battery. Perform the functional check listed in Table 3-1.

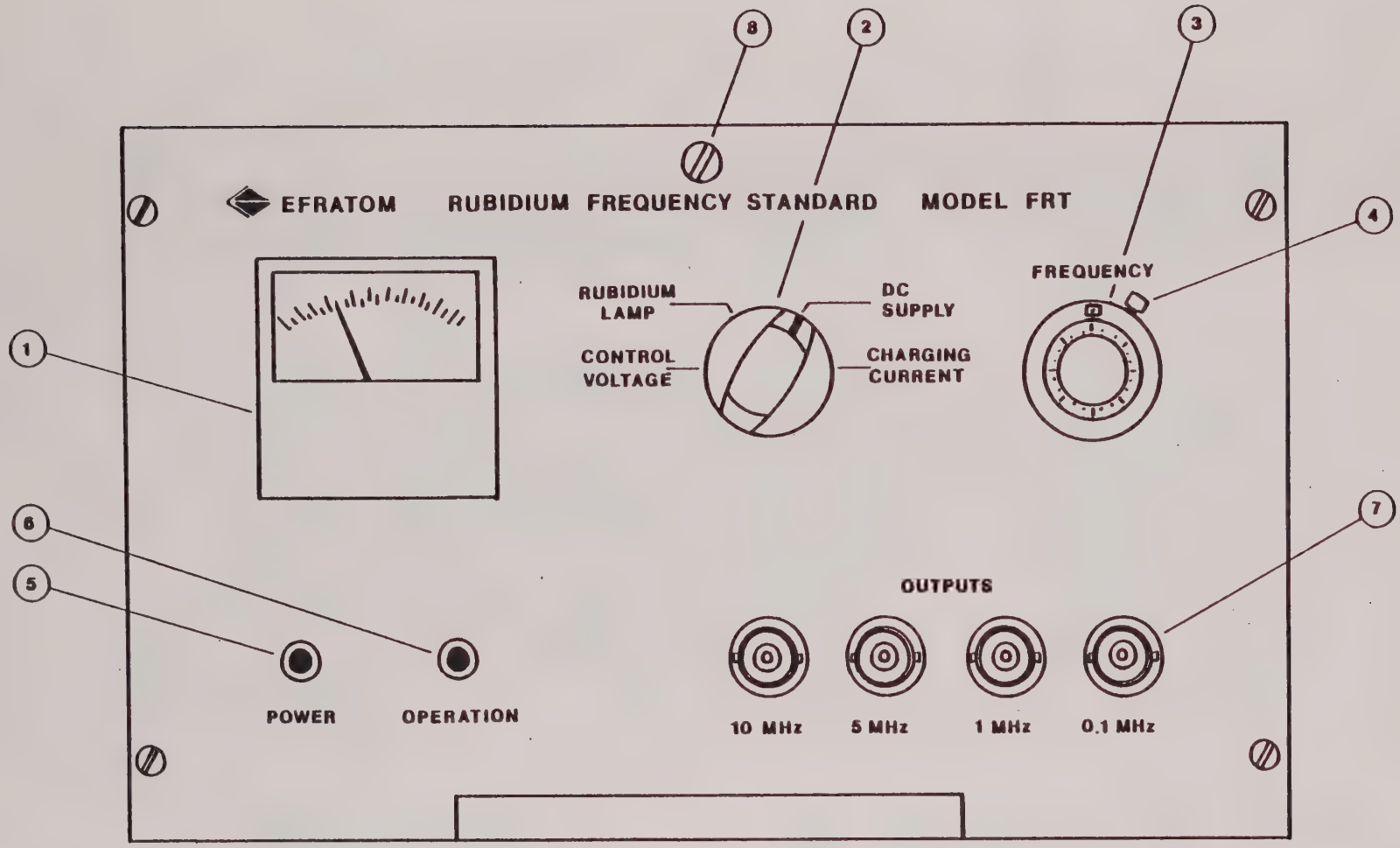
3-10. FREQUENCY OUTPUTS

3-11. Each of the four frequencies, 10 MHz, 5 MHz, 1 MHz, and 0.1 MHz, are available from BNC connectors on the front and rear panel, J1 thru J8. Output levels are approximately 1 V rms when terminated with 50 ohms resistive load. The outputs are mutually decoupled at 40 dB.

TABLE 3-1

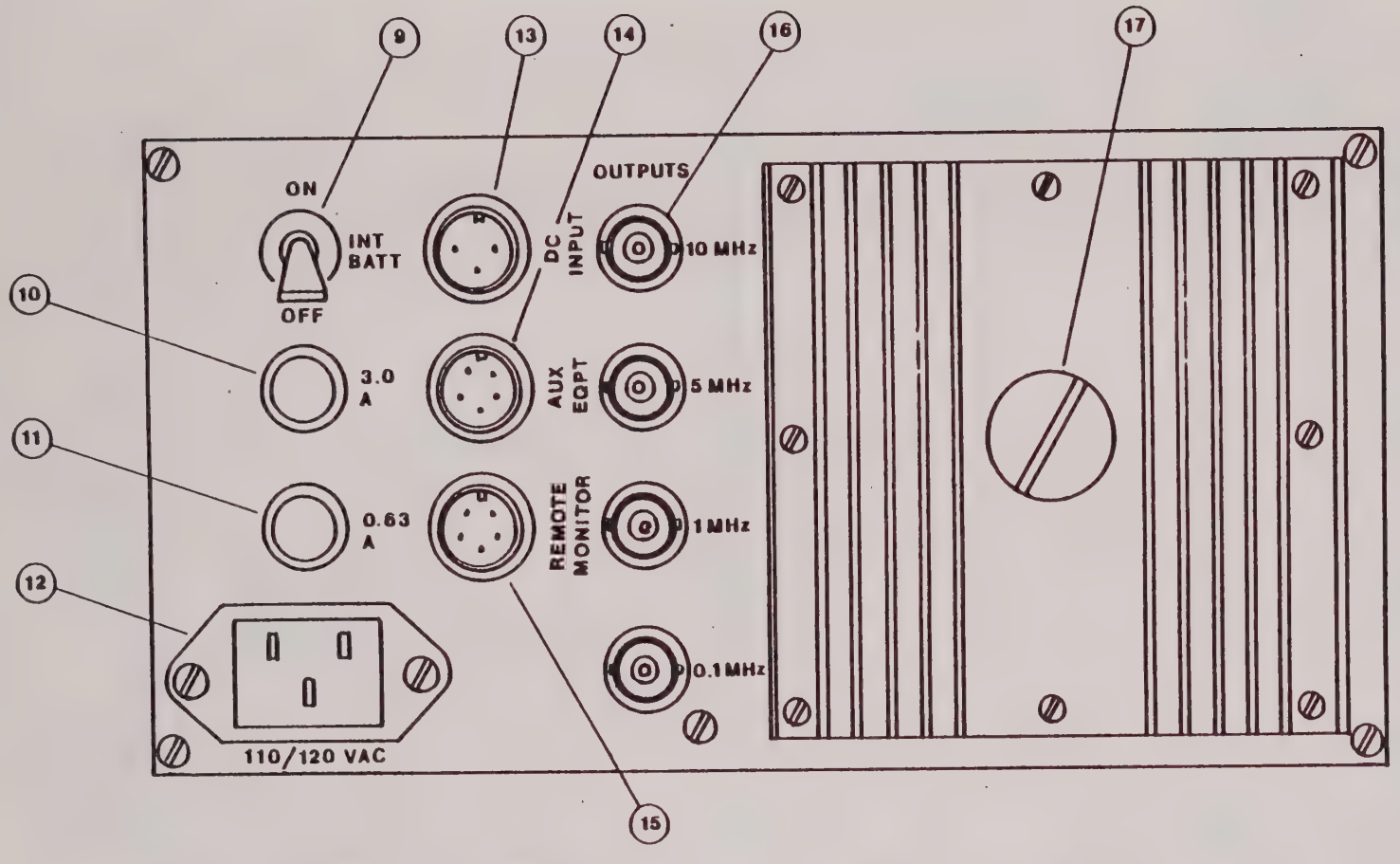
OPERATING CHECKS

Switch Position	Meter indication	Function monitored
CHARGING CURRENT		Connect AC power
	+10 to +15	Battery is not sufficiently charged. Continue operating from AC line.
	0 to +5	Battery is sufficiently charged. Disconnect AC power.
	-13 to -15	FRT is operating on internal battery (discharging).
DC-SUPPLY	Black Range	Battery voltage is sufficient.
	Below Black Range	Battery voltage is insufficient.
RUBIDIUM-LAMP	Black Range	Correct rubidium lamp light voltage.
CONTROL VOLTAGE	+5 to +40	Control voltage for VCXO. If limits of range are approached, correct as described in 4-11.



1. METER
2. METER FUNCTION SWITCH , S2
3. FREQUENCY ADJUST VERNIER , R4
4. FREQUENCY ADJUST LOCK
5. POWER INDICATOR
6. ATOMIC LOCK INDICATOR
7. FREQUENCY OUTPUTS , J1 to J4
8. RACK MOUNTING SCREW

FIGURE 3-1. FRONT PANEL



9. INTERNAL BATTERY SWITCH, S1
10. EXTERNAL D. C. SOURCE FUSE, F2
11. A. C. POWER FUSE, F1
12. A. C. POWER INPUT, J12
13. D. C. POWER INPUT, J9
14. REMOTE FREQ. CONTROL/INT. BATTERY OUTPUT, J10
15. ATOMIC LOCK REMOTE MONITOR, J11
16. FREQUENCY OUTPUT: BNC CONNECTORS, J5 to J8
17. LAMP ACCESS COVER

FIGURE 3-2. REAR PANEL

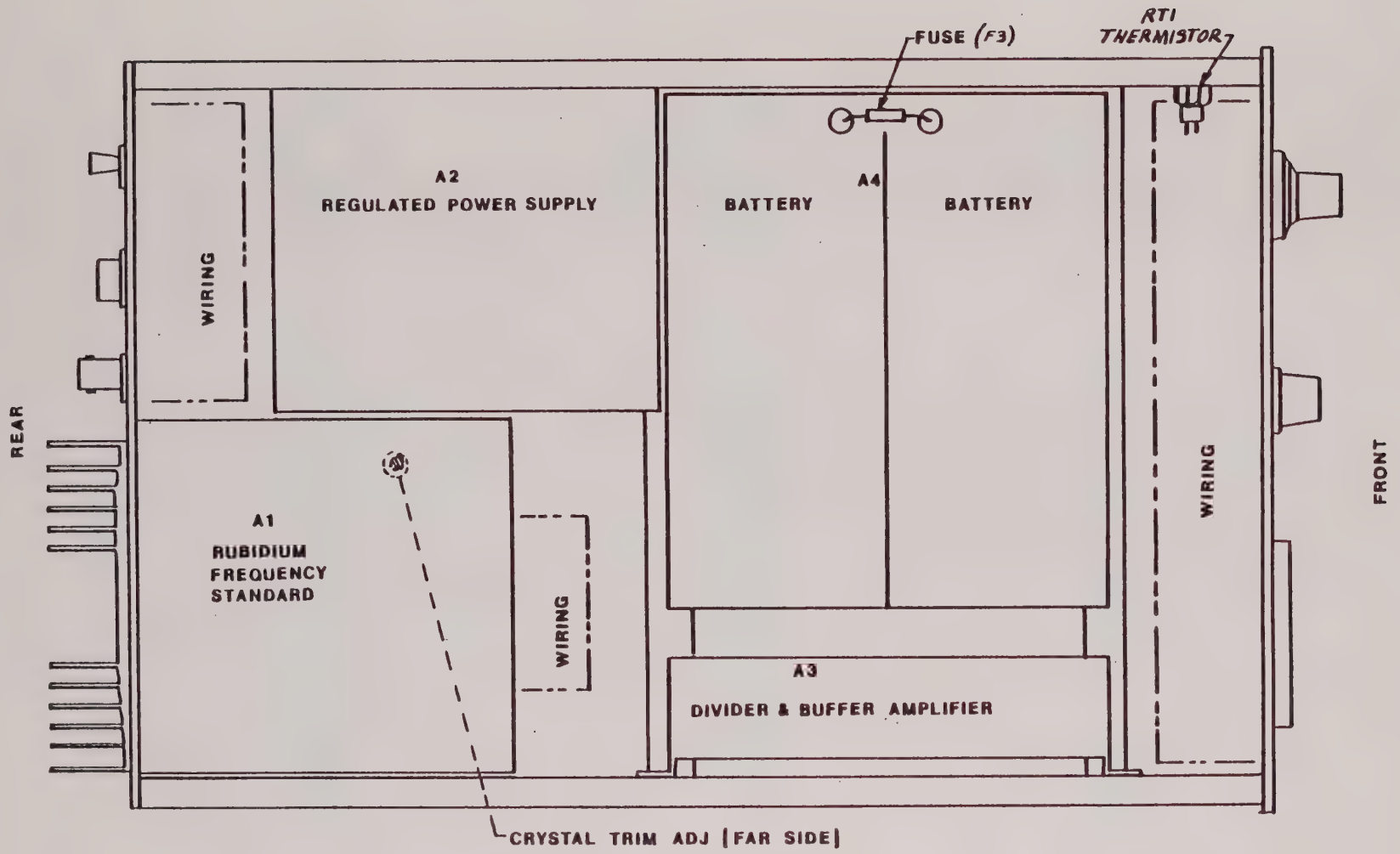
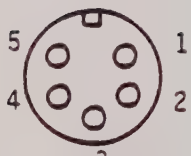


FIGURE 3-1 TOP VIEW

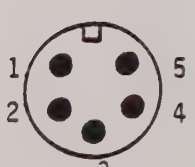
J9
DC INPUT

J9 Part Number: Amphenol 91-T-3262-9
Mating Connector: Amphenol 91-T-3261-1



J10
AUX. EQPT.

J10 Part Number: Amphenol 91-T-3363-9
Mating Connector: Amphenol 91-T-3360-1



J11
REMOTE MONITOR

J11 Part Number: Amphenol 91-T-3362-9
Mating Connector: Amphenol 91-T-3361-1

Figure 3-4. Connectors: Rear Panel

SECTION 4

MAINTENANCE AND CALIBRATION

4-1. FACTORY SERVICE

4-2. If the FRT should require service within the warranty period, contact the Efratom Sales Department for arrangements to return it to the Efratom Service Department for repair. Specify both model and complete serial number in all correspondence and the type of malfunction.

4-3. MAINTENANCE

4-4. REPAIR PROCEDURE

4-5. Field repair is limited to test equipment available and the skill level of maintenance personnel. Normal maintenance of the FRT is limited to frequency adjustment, compensation for crystal aging, rubidium lamp replacement, and battery maintenance. It is recommended that the FRT be returned to Efratom if more extensive repairs should be required.

4-6. FREQUENCY ADJUSTMENT

The front panel control labeled FREQUENCY, is provided for adjusting the frequency of the model FRT-L within a range of 2×10^{-9} with a resolution of approximately 2×10^{-12}. The model FRT-H may be adjusted within a range of 1×10^{-9} with a resolution of approximately 1×10^{-12}. Rotating the control clockwise will increase the frequency, while rotating the control counterclockwise will decrease the frequency.

In addition, frequency adjustments can be made from remote locations by connecting auxiliary equipment into connector J10, located on the back panel.

4-8. The Model FRT can be interfaced with an LF/VLF receiver, e.g. Efratom Model EFR, and synchronized to any one of the LF/VLF standard frequency transmitters such as WWVB, GBR, and DCF77. The receiver generates an error signal which controls the FRT output frequency at AT. In a laboratory environment this system maintains an extremely accurate frequency with a stability of a few parts in 10^{12}. It can be used as an economical alternative to a primary cesium standard.

4-9. Frequency stability measurements necessary to determine the performance of the Model FRT require special test equipment. Test set-up and various test methods are described elsewhere (e.g. NBS-Publications).

4-10. For functional check a method is described in Figure 4-1, which allows a satisfactory evaluation of the frequency stability.

4-11. COMPENSATION FOR CRYSTAL AGING

4-12. The effect of crystal aging will be indicated by a deviation of the control voltage as displayed on the front panel meter. If the meter indicates a reading approaching +5 to +40, an adjustment of the crystal oscillator base frequency is required. This adjustment shall be made after a minimum of one hour of continuous operation. Remove the case from the FRT, or if it is mounted in a rack, slide the unit out for access to the crystal trim adjustment cover (Figure 3-3). Remove the adjustment cover and insert the alignment tool into the oscillator trimmer capacitor.

Caution: Turn the trimmer slowly.

Turning the trimmer clockwise will increase the oscillator control voltage. This adjustment should be set to indicate approximately +20 on the front panel meter.

4-13. RUBIDIUM LAMP REPLACEMENT

4-14. Turn off power to the unit before replacing the rubidium lamp. Remove the large slotted screw in the heatsink of the FRK module A1 (Figure 3-2, Item 17). Replace the lamp with the use of a screwdriver or the special lamp replacement tool available from Efratom.

CAUTION:

1. The rubidium lamp may be extremely hot upon removal.
2. The replacement lamp must be clean and free of any oils or grease prior to installation.

4-15. BATTERY MAINTENANCE

4-16. When the instrument is shipped from the factory, the battery is fully charged. Maximum battery capacity can be sustained only if the battery is maintained on trickle charge or is recharged every two to six months depending on conditions. To check the condition of the battery, disconnect the AC power after the battery is fully charged. Operate the FRT for approximately thirty minutes on the internal battery. With the meter function switch on CHARGING CURRENT, the meter indication should not drop below 40.

NOTE:

It is recommended that the FRT be operated with the battery switch ON to maintain maximum battery capacity.

4-17. If the instrument is operating from the internal battery, set the circuit check switch on the front panel to CHARGING CURRENT. Observe that the MONITOR meter indicates between -13 to -15. When AC prime power is applied again the meter may indicate +10 to +15, decreasing with time to indicate that the batteries are being trickle charged.

NOTE:

If the FRT is shipped or stored over a long period, the battery switch should be placed in the OFF position to prevent deep discharge. However, after two to six

months of storage, the batteries may be discharged so far that recharging is necessary. It is recomended that the FRT be warmed up for at least ten minutes before the battery switch is turned on.

FUNCTIONAL FREQUENCY STABILITY TEST

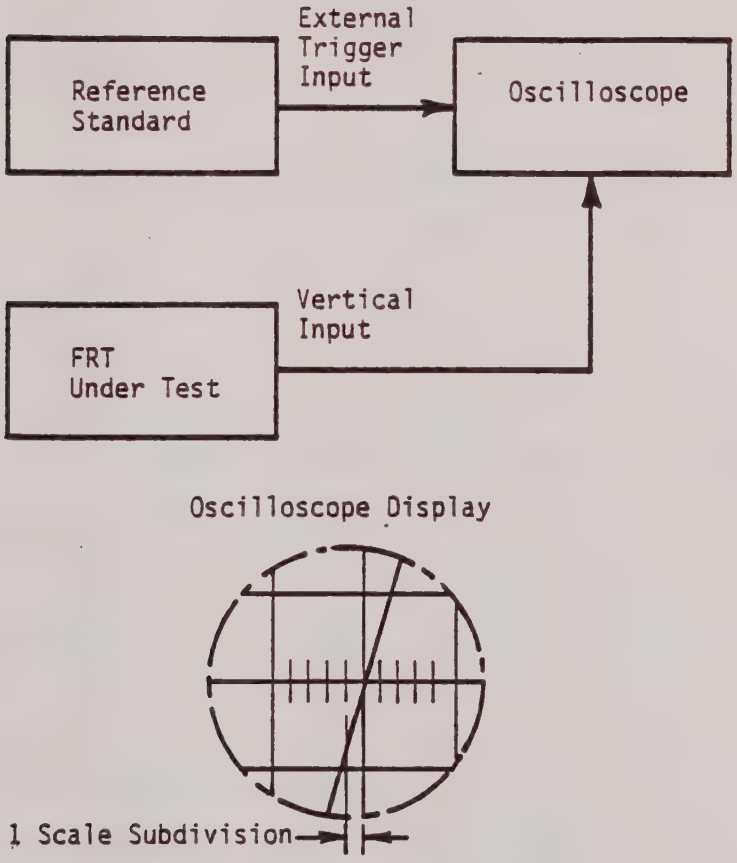


FIGURE 4-1

Equipment Required:

Oscilloscope, (Tektronix Model 465 or equivalent)
Reference Standard, (Efratom FRT-EFR SYSTEM
or equivalent)

The difference in frequency between the reference standard and the FRT under test appears as a phase change on the oscilloscope. The fractional frequency difference can be calculated by observing the phase change, as seen on the

oscilloscope and using the following formula:

$$\frac{\Delta f}{f} = \frac{\Delta t}{t}$$

where: $\frac{\Delta f}{f}$ = fractional frequency difference

Δt = amount of phase change (in μs or ns) during time t (in seconds)

t = see Δt above

Connect the reference standard and the FRT under test to the oscilloscope as shown in Figure 4-1. To insure proper results, the trigger frequency must be equal to or lower than the unit under test. Set the timebase selector to maximum sweep. On the Tektronix, Model 465 oscilloscope, this is 0.05 μs/div. Push the X10 MAG button to increase the maximum sweep to 5 ns/div. One scale subdivision as shown in Figure 4-1 will then be equal to 1 ns (Δt).

Tune the FRT under test with the frequency adjust vernier, so that the waveform on the scope is stationary. Position the waveform on the screen. A drift toward the left of the screen indicates that the frequency of the FRT under test is high and vice versa.

To calculate the fractional frequency difference between the reference standard and the FRT under test, measure the time (t) required for the waveform to move one subdivision (Δt) on the scope and use the formula given above. For example, if the waveform moves one subdivision (1 ns) on the scope in 10 seconds, then the fractional frequency difference would be 1 ns/10 s or 1×10^{-10}.

SECTION 5

CIRCUIT DESCRIPTION

5-1. GENERAL

5-2. The Model FRT contains a Rubidium Frequency Standard, EFRATOM Model FRK providing a sinusoidal output (A1); a regulated power supply (A2); frequency dividers and buffer amplifiers providing the eight output frequencies (A3); and a rechargeable battery (A4).

5-3. For detailed information on the FRK (A1) please refer to the respective FRK manual.

5-4. REGULATED POWER SUPPLY (A2)

5-5. The prime power voltage 110/220 VAC is converted to 30 VAC, rectified and filtered by C1 to approximately 36 VDC. This voltage is passed through a current limiting regulator consisting of Q1 through Q5. The output level at ambient room temperature is approximately 25 VDC at a maximum current of 2.2 A.

5-6. FREQUENCY DIVIDERS AND BUFFER AMPLIFIERS (A3)

5-7. Models FRT-L and FRT-H use integrated TTL circuits U2, U3, and U4 to divide the 10 MHz input reference frequency into 5 MHz, 1 MHz, and 0.1 MHz. Model FRT-LN uses U3, U4, and T5 to change the 5 MHz, input reference frequency into 10 MHz, 1 MHz, and 0.1 MHz. In each model, the above frequencies are applied to preamplifiers Q25 to Q28 and then to buffer amplifiers Q17 to Q24. There is approximately 40 dB decoupling between common output frequencies and 1V rms output amplitude when terminated with a 50 ohm resistive load.

5-8. A regulated 20 VDC to the buffer circuits is provided by U1, Q29, and Q30, while Q31 provides 5 VDC to the frequency dividers.

5-9. BATTERY OVERCHARGE PROTECTION

5-10. To prevent overcharging the internal battery, the circuit on the power supply board (A2) consisting of R13, R21, plus a thermistor RT1 mounted on the frame, function to sense an increase of ambient temperature. If the ambient temperature increases, the temperature sensing circuit will decrease the charge voltage to the battery.

5-11. The Model FRT can also operate from an external DC source connected through receptacle J9. An input voltage of +23 to +32 VDC is required. In case of primary power failure the external battery will automatically take over. The POWER indicator will go off, while the OPERATION indicator will remain on, indicating proper operation of the FRT.

5-12. Receptacle J10 provides DC power for optional equipment, such as EFRATOM Model EFR or EDU. The capacity of the built-in battery depends on the total load and the ambient temperature.

5-13. INTERNAL BATTERY

5-14. The battery used is a GEL CELL type. For detailed information refer to the battery manufacturer's specifications:

Power-Sonic Corp.
3106 Spring St.,
Redwood City, Ca. 94064

PARTS LIST	EFRATOM	CONTRACT NO.	PL 70358	REV A 6/27/8
LIST TITLE: FRT ASSEMBLY		AUTHENTICATION	CODE IDENT	SHEET 1 OF 2

ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENT NUMBER	DESCRIPTION	SPECIFICATION OR REFERENCE	REF DESIGNATION
1	1		MODEL FRK	Rb FREQ. STANDARD	EFRATOM	A1
2	1		70359	POWER SUPPLY ASSY	EFRATOM	A2
3	1		70360	DIVIDER & BUFFER AMPL ASSY	EFRATOM	A3
4	2		PS-1245	BATTERY 12VDC	POWER SONIC	B1-2
5	2		RLC-201	DIODE, LED	LITRONIX	CR1-2
6	1		1N4151	DIODE, ZENER	FAIRCHILD	CR3
7	1		213.700	FUSE .70A, 250V	LITTELFUSE	F1
8	1		213003	FUSE 3A, 250V	LITTELFUSE	F2
9	1		275003	FUSE 3A, 125V	LITTELFUSE	F3
10	8		UG-657/U	CONNECTOR, BNC	AMPHENOL	J1-J8
11	1		91-T-3262-9	CONNECTOR, DC INPUT (3P)	AMPHENOL	J9
12	1		91-T-3363-9	CONNECTOR, AUX EQPT (5S)	AMPHENOL	J10
13	1		91-T-3362-9	CONNECTOR, REMOTE MONITOR (5P)	AMPHENOL	J11
14	1		EAC-301	CONNECTOR, AC INPUT	SWITCHCRAFT	J12
15	1		24D02C20C	RELAY, 2AMP DPDT	ITT	K1
16	1		260-115	METER (TRIPLETT)	EFRATOM	M1
17	2		CB3925	RESISTOR 3.9K ± 5% ¼W	ALLEN-BRADLEY	R1-2
18	1		CB4735	RESISTOR 47K ± 5% ¼W	ALLEN-BRADLEY	R3
19	1		3540S-1-102	RESISTOR, VAR 1 K	BOURNS	R4
20	1		K252	THERMISTOR 6K	SIEMENS	RT1
21	1		8280K-23F	SWITCH SPDT	CUTTLER-HAMMER	S1
22	1		44A60-02-1-Q4N	SWITCH, ROTARY	GRAYHILL	S2
23	1		260-111-1	FRONT PANEL	EFRATOM	
24	1		260-121-1	REAR PANEL	EFRATOM	
25	2		260-311	SIDE BAR, BOTTOM	EFRATOM	

PARTS LIST	EFRATOM	CONTRACT NO.	PL 70358	REV A 6/27/8
LIST TITLE: FRT ASSEMBLY		AUTHENTICATION	CODE IDENT	SHEET 2 OF 2

ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENT NUMBER	DESCRIPTION	SPECIFICATION OR REFERENCE	REF DESIGNATION
26	1		260-312	SIDE BAR, TOP RIGHT	EFRATOM	
27	1		260-313	CROSS BAR, FRONT		
28	1		260-314	CROSS BAR, REAR		
29	1		260-316	BAR, P.S. SUPPORT		
30	1		260-317	SIDE BAR, TOP LEFT		
31	1		260-318	BLOCK, RELAY MTG		
32	2		260-321	BAR, BATT HOLD DOWN		
33	2		260-322-1	BOLT, BATTERY, LONG		
34	4		260-322-2	BOLT, BATTERY, SHORT	EFRATOM	
35	1		22129	KNOB	ODENWALDER KUNSTSTOFFWERKE	
36	1		H-492-3	DIAL, TURN COUNTING	BOURNS	
37	1			HANDLE	SCHROFF	
38	2		E6011	FUSEHOLDER	LITTLEFUSE	
39	1		142-0201-001	CONNECTOR-OSM PLUG	E.F. JOHNSON	
	REF		70352	SCHEMATIC	EFRATOM	

PARTS LIST | EFRATOM | CONTRACT NO. | PL 70359 | REV A 6/27/8

LIST TITLE: FRT POWER SUPPLY ASSY | AUTHENTICATION | CODE IDENT | SHEET 1 OF 2

ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENT NUMBER	DESCRIPTION	SPECIFICATION OR REFERENCE	REF DESIGNATION
1	1		260-231	CHASSIS	EFRATOM	
2	1		260-232	COVER	EFRATOM	
3	1		260-233	HEAT SINK	EFRATOM	
4	1		260-235	CIRCUIT BOARD	EFRATOM	
5	1		CGS412V050R3COPS	CAPACITOR 4100 UF 50V	MALLORY	C1
6	1		ET470X063A6	CAPACITOR 47 UF 40V	MEPCO	C2
7	1		MDA-960-2	DIODE, RECTIFIER BRIDGE	MOTOROLA	CR1
8	4		MR831	DIODE	MOTOROLA	CR2,6,7,8
9	2		IN4151	DIODE, ZENER	FAIRCHILD	CR3,5
10	1		IN5231B	DIODE	MOTOROLA	CR4
11	1		1N5365B	DIODE	MOTOROLA	CR9
12	1		275003	FUSE 3A 125V	LITTELFUSE	F1
13	2		2N2895	TRANSISTOR	MOTOROLA	Q1,2
14	1		2N2907	TRANSISTOR	MOTOROLA	Q3
15	1		2N4919	TRANSISTOR	MOTOROLA	Q4
16	1		2N3055	TRANSISTOR	MOTOROLA	Q5
17	2		CB1835	RESISTOR 18K ± 5% ¼W	ALLEN-BRADLEY	R2,14
18	2		CB3325	3.3K		R3,7
19	2		CB1015	100Ω		R4,20
20	1		CB5615	560Ω		R12
21	1		CB8225	8.2K		R15
22	1		CB1035	10K		R21
23	1		CB1825	1.8K ¼W		R22
24	8		EB1R25	1.2Ω ± 5% ½W		R8-11, R16-19
25	2		EB1525	RESISTOR 1.5K ± 5% ½W	ALLEN-BRADLEY	R5,6

PARTS LIST	EFRATOM	CONTRACT NO.	PL 70359	REV A 6/27/8
LIST TITLE: FRT POWER SUPPLY ASSY		AUTHENTICATION	CODE IDENT	SHEET 2 OF 2

ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENT NUMBER	DESCRIPTION	SPECIFICATION OR REFERENCE	REF DESIGNATION
26	1		GB1525	RESISTOR 1.5K ± 5% 1w	ALLEN-BRADLEY	R1
27	1		NP253M	RESISTOR, VAR 25K	ALLEN-BRADLEY	R13
28	1		260-238	TRANSFORMER	EFRATOM	T1
29	23		1592-2HTD	TERMINAL, SOLDER	KEYSTONE	
30	1		VR3	CLAMP	MALLORY	
	REF		70353	SCHEMATIC	EFRATOM	
	REF		70357	CIRCUIT BOARD ASSEMBLY	EFRATOM	

PARTS LIST	EFRATOM	CONTRACT NO.	PL 70360	REV A 6/27/78
LIST TITLE: FRT-DIVIDER & BUFFER AMPL		AUTHENTICATION	CODE IDENT	SHEET 1 OF 3

ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENT NUMBER	DESCRIPTION	SPECIFICATION OR REFERENCE	REF DESIGNATION
1	1		260-251	CHASSIS	EFRATOM	
2	1		260-252	COVER	EFRATOM	
3	1		70350	CIRCUIT BOARD	EFRATOM	
4	39		CK06BX104K	CAPACITOR .1UF	MIL-C-11015	C1-32, 41-44,53-55
5	4		EDPU 4x4 NPO	SELECT VALUE	STETTNER-TRUSH	C33-36
6	4		EDPU 4x4 NPO	82PF NPO	STETTNER-TRUSH	C37-40
7	6		3439-100E-682-Z5U	6800PF	AVX	C45-48,51,52
8	1		T320C106M035AS	10UF 35V TANT	KEMET	C49
9	1		CK06BX224K	.22UF	MIL-C-11015	C50
10	THIS ITEM	NOT USED				
11	38		1592-2HTD	TERMINAL, SOLDER	KEYSTONE	E1-E26
12	19		1N4151	DIODE, ZENER	FAIRCHILD	CR1-18,20
13	THIS ITEM	NOT USED				
14	1		1N823	DIODE, ZENER	MOTOROLA	CR19
15	9		2N2222A	TRANSISTOR	ITT	Q1-8,32
16	16		2N2907	TRANSISTOR	MOTOROLA	Q9-24
17	4		2N5484	TRANSISTOR		Q25-28
18	1		2N3906	TRANSISTOR		Q29
19	1		MJE702	TRANSISTOR	MOTOROLA	Q30
20	1		LM340LAH5.0	VOLTAGE REGULATOR	NATIONAL	Q31
21	9		CB1025	RESISTOR 1K ± 5% ¼W	ALLEN-BRADELY	R1-8,80
22	20		CB12R5	12Ω ± 5% ¼W		R9-24,57-60
23	8		CB1525	1.5 ± 5% ¼W		R25-32
24	7		EB2715	270Ω ± 5% ½W		R33-40
25	8		CB2745	RESISTOR 270K ± 5% ¼W	ALLEN-BRADLEY	R41-48

PARTS LIST	EFRATOM	CONTRACT NO.	PL 70360	REV A 6/27/8
LIST TITLE: FRT-DIVIDER & BUFFER AMPL		AUTHENTICATION	CODE IDENT	SHEET 2 OF 3

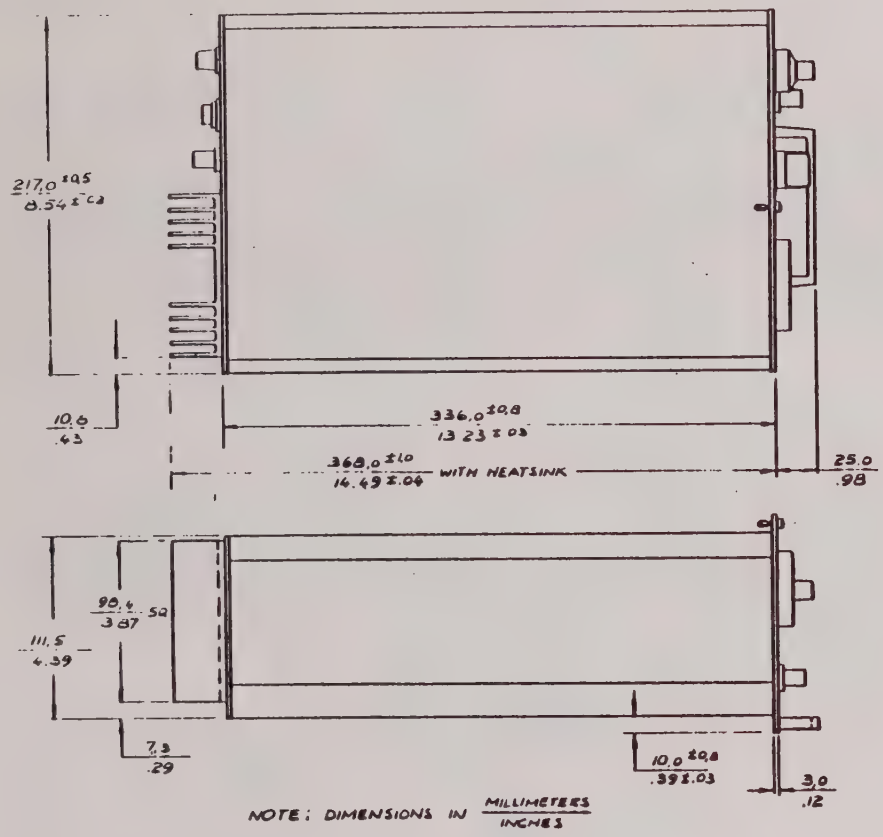
ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENT NUMBER	DESCRIPTION	SPECIFICATION OR REFERENCE	REF DESIGNATION
26	13		CB1015	RESISTOR 100Ω ± 5% ¼W	ALLEN-BRADLEY	R49-52,61-68,76
27	4		CB1045	100K ± 5% ¼W		R53-56
28	2		CB1235	12K ± 5% ¼W		R69,72
29	1		CB2225	2.2K ± 5% ¼W		R70
30	1		CB...	SELECT VALVE		R71
31	1		CB6825	6.8K ± 5% ¼W		R73
32	1		CB1825	1.8K ± 5% ¼W		R74
33	1		CB1035	10K ± 5% ¼W		R75
34	1		CB1R65	1.6Ω ± 5% ¼W		R77
35	2		EB1015	100Ω ± 5% ½W		R78,79
36	1		CB4725	RESISTOR 4.7K ± 5% ¼W	ALLEN-BRADLEY	R81
37	2		70351-1	TRANSFORMER 13:3	EFRATOM	T1,T2
38	1		70351-3	TRANSFORMER 26:6	EFRATOM	T3
39	1		70351-4	TRANSFORMER 39:9	EFRATOM	T4
40	1		LM741HM-QB	OP AMPL	FAIRCHILD	U1
41	1		SN7472	TTL FLIP-FLOP	NATIONAL	U2
42	2		SN74LS90	TTL DECADE COUNTER	NATIONAL	U3,4
	REF		70349	SCHEMATIC	EFRATOM	
	REF		70348	CIRCUIT BOARD ASSY	EFRATOM	

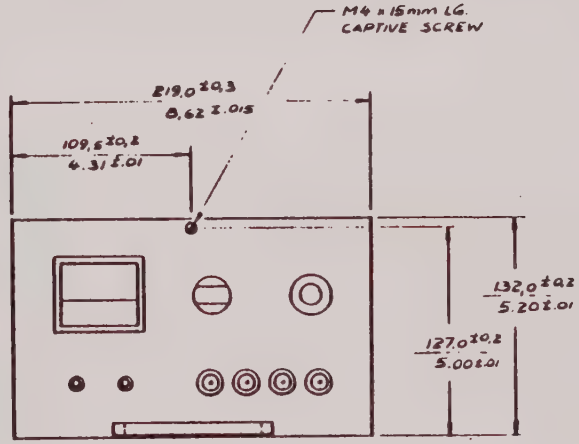
PARTS LIST	EFRATOM	CONTRACT NO.	PL 70360	REV A 6/27/8
LIST TITLE: FRT-DIVIDER & BUFFER AMPL LN		AUTHENTICATION	CODE IDENT	SHEET 3 OF 3

ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENT NUMBER	DESCRIPTION	SPECIFICATION OR REFERENCE	REF DESIGNATION
1	1		3439-100E-682-Z5U	CAPACITOR 6800 PF	AUX	C56
2	1		CK05BX820K	82PF NPO	MIL-C-11015	C57
3	1		CK05...	SELECT	MIL-C-11015	C58
4	1		CK06BX104K	CAPACITOR .1UF	MIL-C-11015	C59
5	1		CB1025	RESISTOR 1K ± 5% ¼W	ALLEN-BRADLEY	R82
6	1		CB5625	5600 Ω		R83
7	1		CB4715	470 Ω		R84
8	1		CB1015	100 Ω		R85
9	1		CB1205	12 Ω		R86
10	1		CB1035	RESISTOR 10K ± 5% ¼W	ALLEN-BRADLEY	R87
11	2		2N2222A	TRANSISTOR		Q33,34
12	1		70351-2	TRANSFORMER	EFRATOM	T5

NOTE: THE COMPONENTS ON THIS SHEET ARE USED WITH THE FRK-LN. (U2 & C53 ARE NOT USED)

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED





NOTE: DIMENSIONS IN MILLIMETERS / INCHES

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM/INCHES
TOLERANCES ARE:
METRIC ±0.5 | INCHES .XX ±.02, .XXX ± | ANGLES ±

CONTRACT NO: FRT

APPROVALS	DATE
DRAWN G.H.	6-3-75
CHECKED	

MATERIAL

FINISH

DO NOT SCALE DRAWING

NEXT ASSY	USED ON
APPLICATION	

EIRATOM Canberra, Inc.

FRT

OUTLINE DWG.
RUBIDIUM FREQUENCY STD., TYPE FRT

SIZE	CODE IDENT NO	DRAWING NO
C		260-005

SCALE ½ SHEET 1 OF 1

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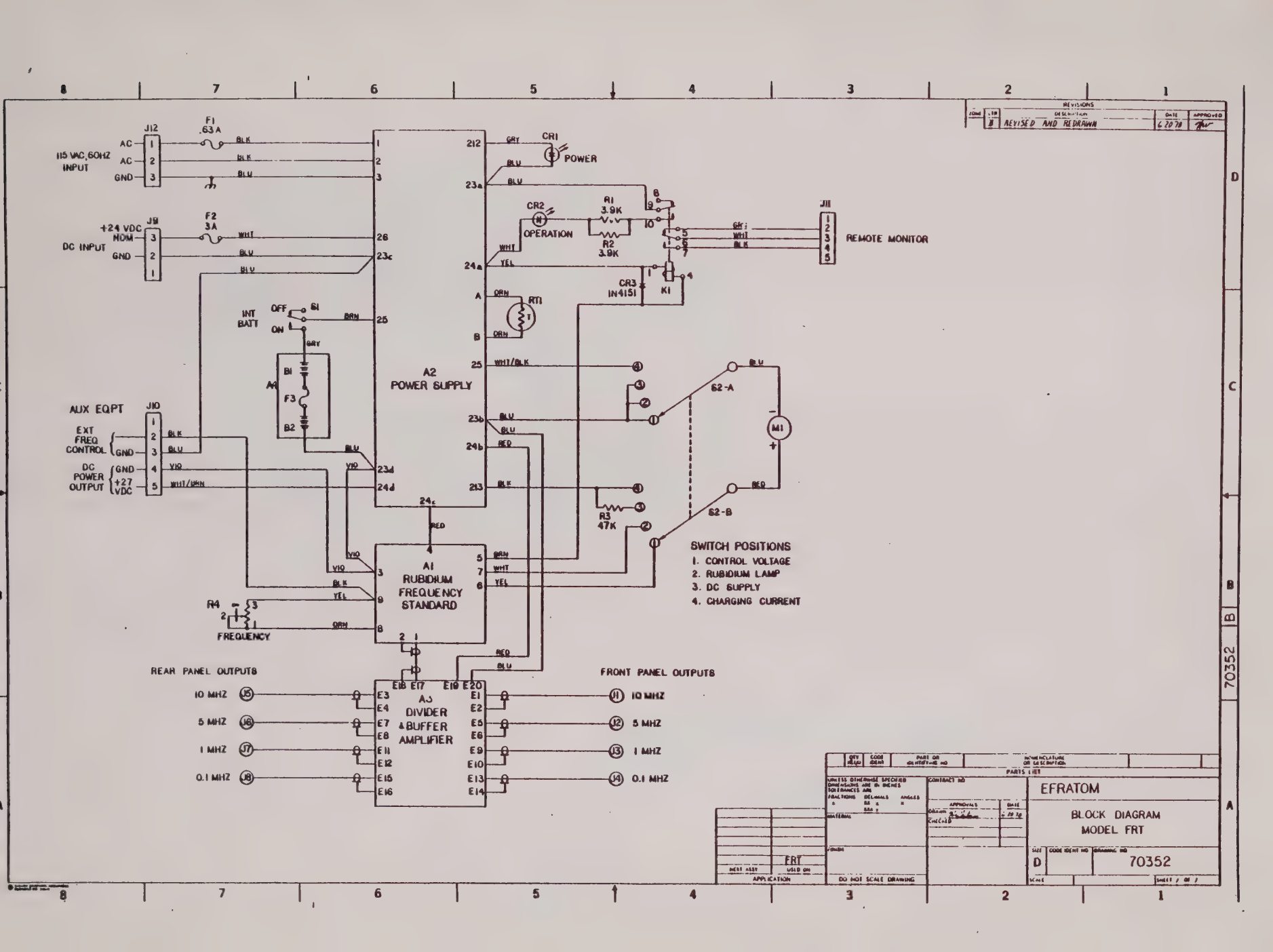
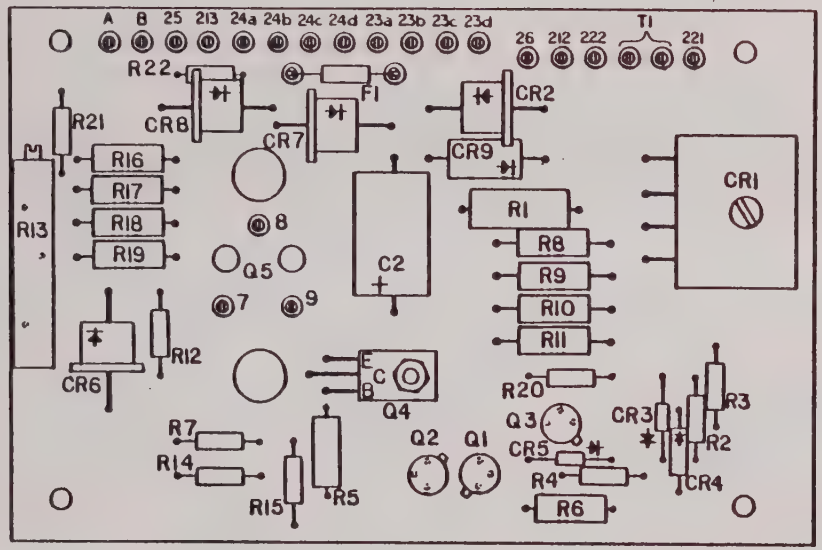

REVISIONS
B REVISED AND REDRAWN 6 20 79
115 VAC, 60HZ INPUT
AC
AC
GND
J12
F1 .63 A
+24 VDC NOM
DC INPUT
GND
J9
F2 3A
A2 POWER SUPPLY
CR1 POWER
CR2 OPERATION
R1 3.9K
R2 3.9K
CR3 IN4151
K1
RT1
J11
REMOTE MONITOR
INT BATT
OFF
ON
S1
A4
B1
F3
B2
AUX EQPT
J10
EXT FREQ CONTROL
GND
DC POWER OUTPUT
GND
+27 VDC
A1 RUBIDIUM FREQUENCY STANDARD
R4
FREQUENCY
S2-A
S2-B
M1
R3 47K
SWITCH POSITIONS
1. CONTROL VOLTAGE
2. RUBIDIUM LAMP
3. DC SUPPLY
4. CHARGING CURRENT
REAR PANEL OUTPUTS
10 MHZ J5
5 MHZ J6
1 MHZ J7
0.1 MHZ J8
A3 DIVIDER & BUFFER AMPLIFIER
FRONT PANEL OUTPUTS
J1 10 MHZ
J2 5 MHZ
J3 1 MHZ
J4 0.1 MHZ
PARTS LIST
EFRATOM
BLOCK DIAGRAM
MODEL FRT
D
70352
FRT
DO NOT SCALE DRAWING
70352

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

CONTRACT NO.

APPROVALS	DATE
DRAWN	6/6/78
CHECKED	

MATERIAL

FINISH

DO NOT SCALE DRAWING

NEXT ASSY	USED ON
	FRT

APPLICATION

EFRATOM

FRT POWER SUPPLY ASSY

SIZE	CODE IDENT NO	DRAWING NO
C		70357

SCALE 2X SHEET 1 OF 1

70357

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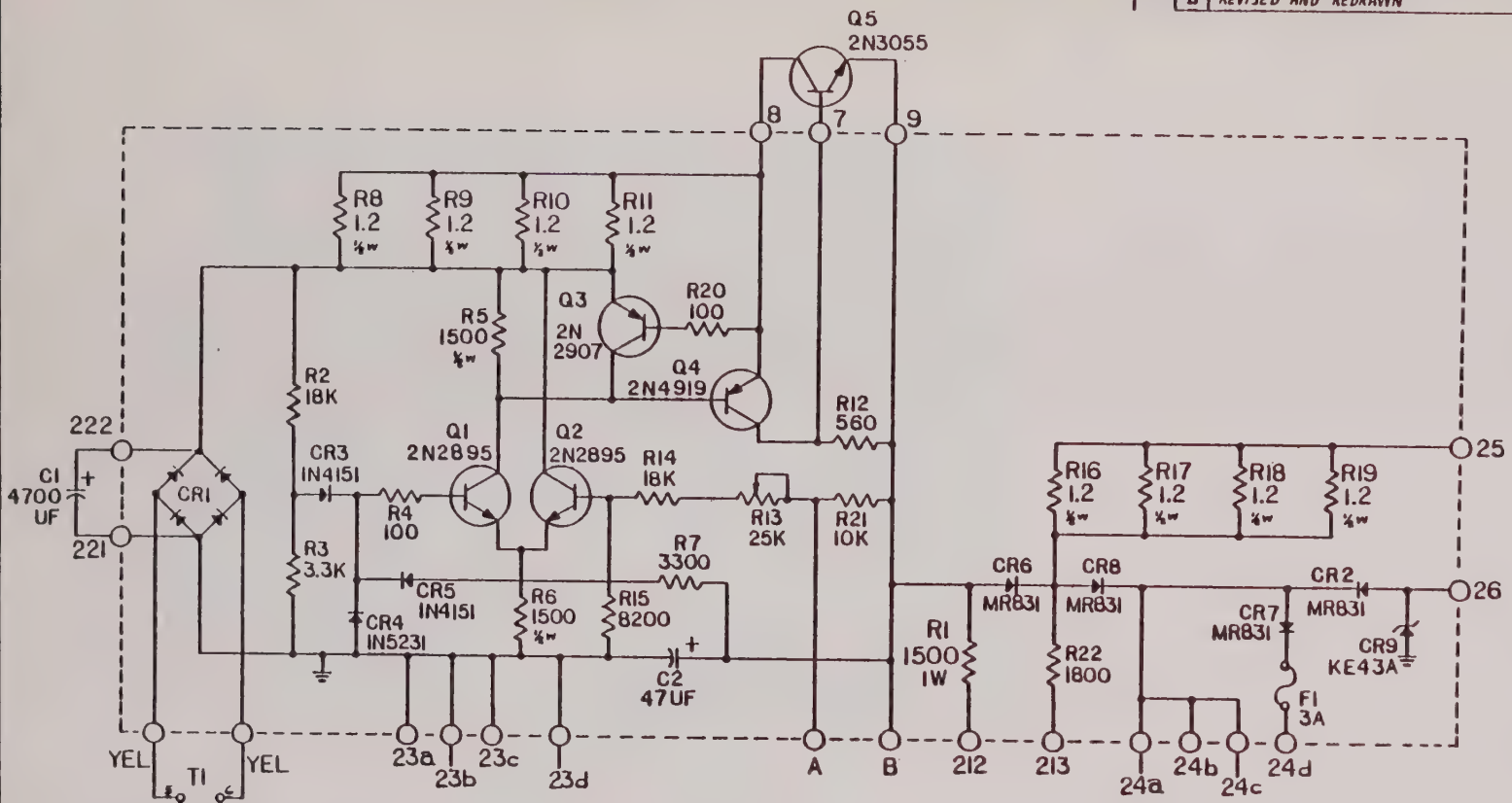
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	REVISED AND REDRAWN	6-22-78	



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

CONTRACT NO.

APPROVALS	DATE
DRAWN	6-1-78
CHECKED	

MATERIAL

FINISH

DO NOT SCALE DRAWING

NEXT ASSY FRT USED ON

APPLICATION

EFRATOM

FRT POWER SUPPLY
SCHEMATIC

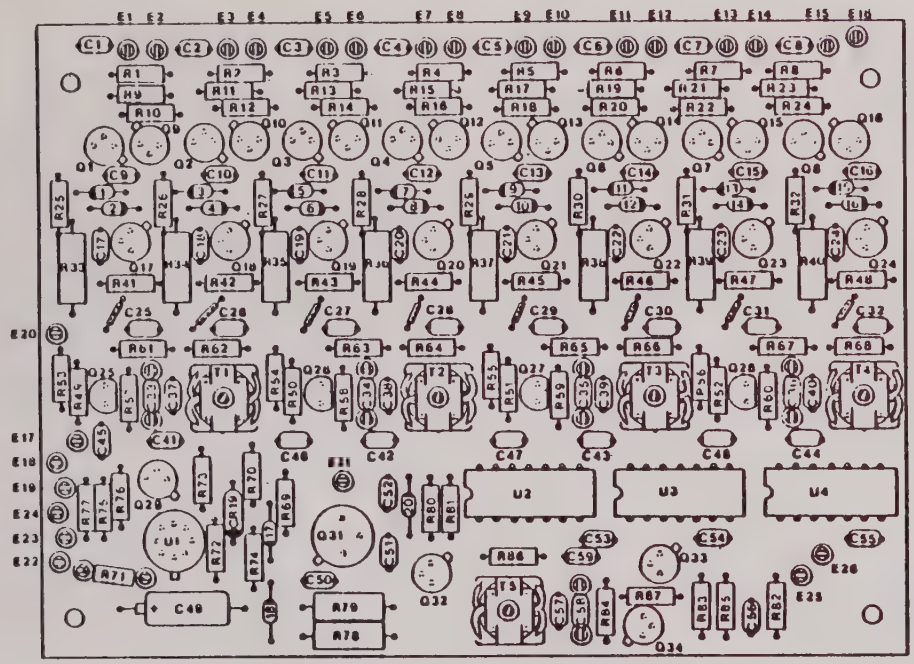
SIZE	CODE IDENT NO	DRAWING NO
C		70353

SCALE

SHEET 1 OF 1

70353 B

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



SEE SEPARATE PARTS LIST NO. 70348

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN M J WHITMORE	JUN 7 78
CHECKED	

EURATOM

DIVIDER & BUFFER AMPL ASSY

SIZE	CODE IDENT NO	DRAWING NO
C		70348

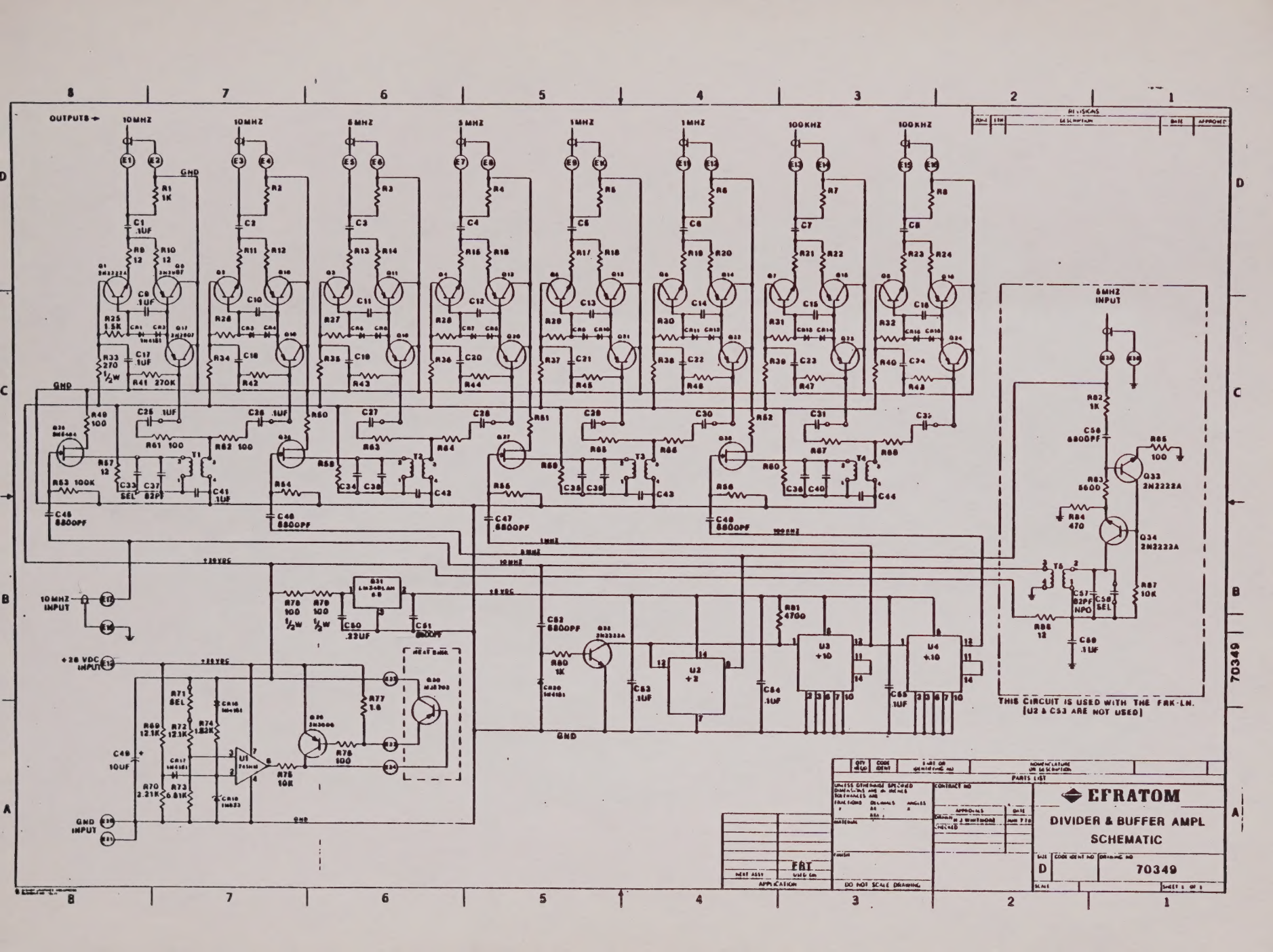
SCALE 2X SHEET 1 OF 1

NEXT ASSY FRT USED ON

APPLICATION

70348

4 3 2 1


OUTPUTS
10MHZ
10MHZ
5MHZ
5MHZ
1MHZ
1MHZ
100KHZ
100KHZ
GND
5MHZ INPUT
10MHZ INPUT
+28 VDC INPUT
GND INPUT
THIS CIRCUIT IS USED WITH THE FRK-LN.
(U2 & C53 ARE NOT USED)
EFRATOM
DIVIDER & BUFFER AMPL
SCHEMATIC
70349
FRT
DO NOT SCALE DRAWING

MP MASTER
MA35362

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Telex 529701 EFRAD-D

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